REMARKS

Claims 1-22 are pending in the present Application. No new matter has been introduced by way of amendment.

Reconsideration and allowance of the claims are respectfully requested in view of the above amendments and the following remarks.

First Claim Rejection Under 35 U.S.C. § 103(a)

Claims 1-5, 8, 10-14, 17, 19, 20, and 21 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over U.S. Patent No. 2,856,179 to Hogan (hereinafter "Hogan") in view of U.S. Patent No. 5,992,582 to Lou et al. (hereinafter, "Lou"), and further in view of U.S. Patent No. 6,394,239 to Carlson (hereinafter "Carlson"). Applicants respectfully traverse this rejection.

Independent Claim 1 is directed to a screw-type magnetorheological damper, comprising a thrust shaft comprising an external threaded surface in threaded communication with a sealed housing, wherein at least one end of the thrust shaft extends from the housing; at least one rotor disposed in the housing comprising a planar surface with a centrally located aperture, wherein the at least one rotor is in direct contact and rotatably engaged with the threaded surface of the thrust shaft; at least one stator spaced apart from and adjacent to the at least one rotor, wherein the at least one stator is fixedly attached to the housing and comprises a centrally located aperture dimensioned to accommodate vertical movement of the thrust shaft and a planar surface substantially parallel to the planar surface of the at least one rotor; a magnetorheological fluid disposed in a space defined by the at least one rotor and the at least one stator; and means for applying a substantially perpendicular magnetic field to the magnetorheological fluid relative to the planar surface of the at least one stator.

Independent Claim 12 is directed to a screw-type magnetorheological damper, comprising a thrust shaft comprising an external threaded surface in threaded communication with a sealed housing, wherein at least one end of the thrust shaft extends from the housing; a plurality of rotors and stators alternatingly arranged in the housing, wherein each of the plurality of rotors comprise

a planar surface with a centrally located aperture, wherein each of the plurality of rotors is in direct contact with and rotatably engaged with the threaded surface of the thrust shaft, wherein each of the plurality of stators is fixedly attached to the housing and comprises a centrally located aperture dimensioned to accommodate vertical movement of the thrust shaft and a planar surface substantially parallel to the planar surface of the plurality of rotors, and wherein alternating stators comprise a permanent magnet or an electromagnet; and a magnetorheological fluid disposed in a space defined by the plurality of rotors and stators.

Independent Claim 21 is directed to a process for operating a screw-type magnetorheological damper for variably converting a linear force to a rotary force, comprising axially applying a force to a thrust shaft of a screw-type magnetorheological damper, wherein the screw-type magnetorheological damper comprises the thrust shaft having an external threaded surface in threaded communication with a sealed housing, at least one rotor disposed in the sealed housing comprising a planar surface with a centrally located aperture, wherein the at least one rotor is in direct contact and rotatably engaged with the threaded surface of the thrust shaft, at least one stator spaced apart from and adjacent to the at least one rotor, wherein the at least one stator is fixedly attached to the housing and comprises a centrally located aperture dimensioned to accommodate vertical movement of the thrust shaft and a planar surface substantially parallel to the planar surface of the at least one rotor, and a magnetorheological fluid disposed in a space defined by the at least one rotor and the at least one stator; and variably applying a substantially perpendicular magnetic field to the magnetorheological fluid relative to the planar surface of the at least one stator so as to variably covert the linear force applied to the thrust shaft into the rotary force.

Hogan is generally directed to shock absorbers adapted for use in aircraft installations.

Lou is generally directed to rotary damping devices that utilize electrorheological fluids and provide electronically controllable damping to various vibrations.

Carlson is generally directed to damping, resistance control, and motion controlling devices based on magnetorheological fluids.

For an obviousness rejection to be proper, the Examiner must meet the burden of establishing a *prima facie* case of obviousness, i.e., that all elements of the invention are disclosed in the prior art; that the prior art relied upon, coupled with knowledge generally available in the art at the time of the invention, contain some suggestion or incentive that would have motivated the skilled artisan to modify a reference or combined references; and that the proposed modification of the prior art had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988); *In re Wilson*, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970); *Amgen v. Chugai Pharmaceuticals Co.*, 927 U.S.P.Q.2d, 1016, 1023 (Fed. Cir. 1996).

Applicants assert that a *prima facie* case of obviousness has not been established because the cited references fail to teach or suggest all elements of Applicants' independent Claims 1, 12, and 21. Specifically, there is no mention or suggestion of at least "a thrust shaft comprising an external threaded surface in threaded communication with a sealed housing".

In making the rejection, the Examiner has cited the embodiment represented by Figure 5 of Hogan as being the most relevant. The Examiner's attention is kindly directed to the text of Hogan regarding the absorber of Figure 5, the relevant portion of which has been reproduced for convenience as shown below.

> Another form of this invention is shown in Figure 5 wherein the viscosity of a liquid, preferably oil, is utilized to resist the movement of the shock absorber.
>
> Here again a housing 70 is provided with a cavity into which a plunger 71 projects. The plunger 71 is provided with a grooved screw portion 72 having a helical groove 73 which cooperates with annular grooves 74 in a nut assembly 76 to define the usual ball cavities in which balls 77 are positioned. Here again a cage 78 is utilized to properly position the balls at the intersection of the grooves 73 and 74. Antifriction thrust bearings 79 axially locate the nut assembly 76 within the housing 70 without restraining the nut against rotation relative thereto. **Fluid seals 31 engage the plunger 71 on either side of the screw portion 72 and in cooperation with the housing 70 retain oil in the area of the screw and nut.** The nut assembly 76 is provided with a series of radially extending fins 82 interspaced with a similar series of radially extending fins 83 mounted on the housing 70. As the nut assembly 76 is rotated relative to the housing 70, the fins 82 rotate with the nut relative to the fins 83 which are fixed on the housing and

> provide a large surface subject to the viscous resistance of the oil within the cavity.
>
> (Hogan; Column 4, line 74 through Column 5, line 21; emphasis added)

As stated in the text, and illustrated in Figure 5 of Hogan, the shaft and the housing are not in threaded communication. The portion of the shaft of Hogan that is communication with the housing is not threaded. Only the portion of the shaft that remains inside of the housing is threaded. Thus, the shaft and housing cannot be in threaded communication as instantly claimed.

Furthermore, upon carefully studying the remainder of the Specification and Figures of Hogan, Applicants note that Hogan as a whole fails to disclose or suggest Applicants' thrust shaft comprising an external threaded surface that is in threaded communication with a sealed housing.

Applicants contend that Lou also fails to disclose or suggest a thrust shaft comprising an external threaded surface that is in threaded communication with a sealed housing. The Examiner states that Lou discloses a screw type damper including a thrust shaft 41 having a screw nut mechanism in threaded communication with a sealed housing, which has been interpreted to be represented by 29. The Examiner cites Lou at Column 4, lines 36-41, which state: "The rotary motion of the rotor 26 of the ER damper 3 is converted from the translational motion of a shaft 41 by a screw-nut mechanism 11 (an efficient version of it can be a ball screw-nut mechanism). **The shaft 41 and the stator 29 undergo a translational motion relative to each other but no or little, if any, rotation."** (Emphasis added). Applicants assert that if the thrust shaft and the housing of Lou were truly in threaded communication, then it would be impossible for Lou to state that the thrust shaft and the housing undergo a translational motion but no rotational motion. Using the cited portion as guidance, Figures 1 and 2 clearly illustrate a shaft and housing that move with translational motion relative to each other, using a screw-nut mechanism to cause only the rotors to rotate with respect to the housing. By making this statement regarding the relative motion of the shaft and housing, Lou, in fact, teaches away from having a thrust shaft that is in threaded communication with the housing. Accordingly, like Hogan, Lou fails to disclose or suggest Applicants' thrust shaft comprising an external threaded surface that is in threaded communication with a sealed housing.

Carlson fails to compensate for the deficiencies of Hogan and Lou. Notably absent from Carlson is any mention or suggestion of a screw-type damper. Instead, Carlson is simply relied upon in the Office Action to establish that magnetorheological fluids can substitute for the electrorheological fluids as disclosed by Lou. Thus, the combination of Hogan, Lou, and Carlson still does not teach or suggest all elements of Applicants independent Claims 1, 12, and 21.

Accordingly, Applicants respectfully request withdrawal of the rejection to independent Claims 1, 12, and 21. Given that Claims 2-5, 8, 10, 11, 13, 14, 17, 19, and 20 depend from, and include all the limitation of, their respective base claims, they too are patentable.

Second Claim Rejection Under 35 U.S.C. § 103(a)

Claims 6, 7, 9, 15, 16, and 18 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over Hogan in view of Lou and Carlson as applied to Claims 1 and 12 in the First Claim Rejection Under 35 U.S.C. § 103(a) above, and further in view of U.S. Patent No. 5,900,184 to Weiss et al. (hereinafter "Weiss"). Applicants respectfully traverse this rejection.

Hogan, Lou, and Carlson are discussed above.

Weiss is generally directed to magnetorheological fluid formulations.

Applicants assert that a *prima facie* case of obviousness has not been established against Applicants independent Claims 1 and 12 because Weiss fails to compensate for the deficiencies of Hogan, Lou, and Carlson. Since Weiss is directed only to magnetorheological fluid compositions, Weiss is silent regarding Applicants' thrust shaft comprising an external threaded surface that is in threaded communication with a sealed housing. Thus, the cited references fail to teach all elements of the claims.

Accordingly, Applicants respectfully request withdrawal of the rejection to Claims 6, 7, 9, 15, 16, and 18.

Third Claim Rejection Under 35 U.S.C. § 103(a)

Claim 22 stands rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over U.S. Patent No. 6,279,701 to Namuduri et al. (hereinafter "Namuduri") in view of U.S. Patent No. 6,471,018 to Gordaninejad et al. (hereinafter "Gordaninejad"). Applicants respectfully traverse this rejection.

Independent Claim 22 is directed to a magnetorheological damper, the damper comprising a cylindrically shaped housing; a magnetorheological fluid disposed in the cylindrically shaped housing; a piston assembly disposed within the cylindrically shaped housing in sliding engagement with the cylindrically shaped housing defining a first chamber and a second chamber, wherein the piston assembly comprises an annular starburst flow channel extending from the first chamber to the second chamber, and an electromagnet centrally disposed in the piston assembly, wherein a cross sectional area provided by the annular starburst flow channel is at least about 30 percent of available cross sectional area of the piston assembly; and a power supply in electrical communication with the electromagnet.

Namuduri is generally directed to magnetorheological fluid dampers with multiple concentric annular flow gaps for increased damping force and turn-up ratios.

Gordaninejad is generally directed to magnetorheological fluid dampers.

Applicants assert that a *prima facie* case of obviousness has not been established because all elements of the rejected claim have not been taught or suggested by the cited art. Specifically, there is no mention or suggestion of an annular starburst flow channel, wherein a cross sectional area provided by the annular starburst flow channel is at least about 30 percent of available cross sectional area of the piston assembly. Namuduri teaches multiple **concentric** annular flow channels. Gordaninejad teaches flow passages on the exterior surface of the piston, which can be straight or curved, such as a spiral, portion of a spiral, or a staircase. Neither reference discloses or suggests an annular starburst flow channel as instantly claimed.

Furthermore, Applicants contend that modifying the flow passage taught by Namuduri and Gordaninejad to a particular shape simply dependent on the damping characteristics desired is not an obvious matter of design choice, nor would it have been obvious to the ordinary skilled worker in the art, as suggested by the Office Action. The Examiner's attention is respectfully directed to the Specification of the instant Application, the relevant portion of which has been reproduced for convenience as shown below.

> A piston bearing 74 is mounted on an annular surface of the piston assembly 52 for permitting smooth sliding contact along a wall of the cylindrically shaped housing 54 while creating a fluidic seal between the first chamber 62 and the second chamber 64. The piston assembly 52 further includes an annular starburst shaped flow channel 76 extending through the piston assembly 52 so as to permit fluid communication of the MR fluid between the first and second chambers 62, 64, respectively. Shown more clearly in Figure 3, **the annular starburst shaped flow channel 76 has a generally jagged shaped cross section, thereby providing the capability of a significantly greater cross sectional surface area than in previous designs.** The cross sectional area provided by the annular starburst flow channel 76 generally depends on the desired application. In order to maximize the turn-up ratio, it is preferred that the cross sectional area provided by the annular star burst flow channel 76 represent at least about 30 percent of the available cross sectional area of the piston assembly 52, with greater than about 40 percent more preferred, and with greater than 50 percent even more preferred (the theoretical upper limit being about 78 percent). In practical use, this can probably be no more than 60 percent as the cell walls require a sufficient thickness, i.e., yield strength, to withstand applied loads. **The increase in volume provided by the annular starburst flow channel 76 increases the shear interface value, thereby enhancing the stroking force.**
>
> (Instant Application, paragraph [0027], emphasis added)

As discussed in paragraph [0027], the annular starburst flow channel shape advantageously provides significantly greater cross sectional surface area than in previous designs. Applicants also point out that Namuduri and Gordaninejad are silent regarding the cross sectional area provided by the shaped fluid passage channel. This instantly claimed feature (i.e., "a cross sectional area provided by the annular starburst flow channel is at least about 30 percent of available cross sectional area of the piston assembly"), as discussed in paragraph [0027], allows for increased shear interface value, which enhances the stroking force compared to previous designs.

The only conclusion that Gordaninejad makes regarding modifying the shape of the flow passages of the magnetorheological fluid is: "Thus, the transverse portions of the flow passages 6 do not need to be perpendicular to the magnetic field and can be located in the pistons, housings, or passages external or internal to the device". (Gordaninejad, Column 8, lines 28-32). There is no discussion of any possible advantages of modifying the shape to have an annular starburst flow channel as instantly claimed.

Therefore modifying Namuduri and/or Gordaninejad in a manner to obtain Applicants' invention as in Claim 22 would not have been obvious to one of ordinary skill in the art.

Accordingly, Applicants respectfully request withdrawal of the rejection to Claim 22.

It is believed that the foregoing amendments and remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants. Accordingly, reconsideration and allowance are requested.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130.

Respectfully submitted,

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